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Serial No.:	09/651,031
Filed:	August 30, 2000
Group Art Unit:	2121
Title:	DEFINING PARAMETERS FOR A FINITE ELEMENTS ANALYSIS CALCULATION IN A COMPUTER-ASSISTED DRAFTING PROGRAM
Our Ref. No.:	G&C 30566.123-US-01

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Confirmation No.: 2037
Due Date: June 18, 2005

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Peter Hummel et al.	Examiner:	Sunray Chang
Serial No.:	09/651,031	Group Art Unit:	2121
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Due Date: June 18, 2005

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:

Inventor: Peter Hummel et al.

Serial #: 09/651,031

Filed: August 30, 2000

Title: DEFINING PARAMETERS FOR A FINITE ELEMENTS ANALYSIS CALCULATION IN A COMPUTER-ASSISTED DRAFTING PROGRAM

Examiner: Sunray Chang

Group Art Unit: 2121

Appeal No.: _________

BRIEF OF APPELLANTS

MAIL STOP APPEAL BRIEF-PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In accordance with 37 CFR §41.37, Appellants' attorney hereby submits the Brief of Appellants on appeal from the final rejection in the above-identified patent application as set forth in the Office Action dated January 18, 2005.

Please charge the amount of $500.00 to cover the required fee for filing this Brief as set forth under 37 CFR §41.20(b)(2) to Deposit Account No. 50-0494 of Gates & Cooper LLP. Also, please charge any additional fees or credit any overpayments to Deposit Account No. 50-0494.

I. REAL PARTY IN INTEREST

The real party in interest is Autodesk, Inc., the assignee of the present application.

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II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences for the above-referenced patent application.

III. STATUS OF CLAIMS

Claims 1-23 are pending in the application.

Claims 1-6, 8, 9, 11-13, and 16-23 were rejected under 35 U.S.C. §102(b) as being anticipated by St. Ville, U.S. Patent No. 5,594,651 (St. Ville). (However, the Office Action specifically refers to claims 1-9, 12-13, and 16-18 and 20-22 with regard to this rejection.)

Claims 10, 11, 19, and 23 were rejected under 35 U.S.C. §103(a) as being unpatentable over St. Ville in view of Roth, U.S. Patent No. 5,289,567 (Roth).

Claims 14 and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over St. Ville in view of Itoh et al., U.S. Patent No. 5,774,124 (Itoh).

Claims 1-23 are being appealed.

IV. STATUS OF AMENDMENTS

No amendments have been made subsequent to the final Office Action.

V. SUMMARY OF THE INVENTION

Briefly, Appellants' invention, as recited in independent claims 1, 16, and 20, is generally directed to an invention that defines at least one parameter for a finite elements analysis (FEA) calculation in a computer-assisted drafting (CAD) program.

Independent claim 1 recites a method for defining at least one parameter for a finite elements analysis (FEA) calculation in a computer-assisted drafting (CAD) program. The method comprises determining a body for which said parameter is to be defined, said body being an entity processed by said CAD program. The method also comprises using at least one graphical function of said CAD program to define a region within a face of said body, said region being used to define a load/support condition for said FEA calculation.

Independent claim 16 recites a computer program product for execution by a general purpose computer for defining at least one parameter for a finite elements analysis (FEA)

calculation in a computer-assisted drafting (CAD) program. The computer program product includes instructions for determining a body for which said parameter is to be defined, said body being an entity processed by said CAD program. The computer program product further includes instructions for defining a region within a face of said body using at least one graphical function of said CAD program, said region being used to define a load/support condition for said FEA calculation.

Independent claim 20 recites an apparatus comprising a general purpose computer programmed for defining at least one parameter for a finite elements analysis (FEA) calculation in a computer-assisted drafting (CAD) program. The general purpose computer is programmed for determining a body for which said parameter is to be defined, said body being an entity processed by said CAD program. The general purpose computer is further programmed for defining a region within a face of said body using at least one graphical function of said CAD program, said region being used to define a load/support condition for said FEA calculation.

With regard to the claims, Appellants' attorney requests that the Board refer to the specification generally. Specific portions of the specification that directly relate to the claims on appeal include:

(a) at page 3, line 15 through page 5, line 21;

(b) at page 7, line 1 through page 9, line 28, and in FIG. 2 as reference numbers 20-52;

(c) at page 10, line 20 through page 14, line 4, and in FIG. 5 as reference numbers 54-94; and

(d) at page 14, line 6 through page 16, line 24, and in FIG. 8 as reference number 96-104.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1-6, 8, 9, 11-13, and 16-23 are anticipated under 35 U.S.C. §102(b) by St. Ville, U.S. Patent No. 5,594,651 (St. Ville). Note, however, that the Office Action specifically refers to claims 1-9, 12-13, and 16-18 and 20-22 with regard to this rejection.

2. Whether claims 10, 11, 19, and 23 are obvious under 35 U.S.C. §103(a) over St. Ville in view of Roth, U.S. Patent No. 5,289,567 (Roth).

3. Whether claims 14 and 15 are obvious under 35 U.S.C. §103(a) over St. Ville in

view of Itoh et al., U.S. Patent No. 5,774,124 (Itoh).

VII. ARGUMENTS

A. The Office Action Rejections

In paragraph (3) of the Office Action, claims 1-6, 8, 9, 11-13, and 16-23 were rejected under 35 U.S.C. §102(b) as being anticipated by St. Ville, U.S. Patent No. 5,594,651 (St. Ville). (However, the subsequent paragraphs (4)-(15) of the Office Action refer to claims 1-9, 12-13, and 16-18 and 20-22 with regard to this rejection.) In paragraph (16) of the Office Action, claims 10, 11, 19, and 23 were rejected under 35 U.S.C. §103(a) as being unpatentable over St. Ville in view of Roth, U.S. Patent No. 5,289,567 (Roth). In paragraph (19) of the Office Action, claims 14 and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over St. Ville in view of Itoh et al., U.S. Patent No. 5,774,124 (Itoh).

Appellants' attorney respectfully traverses the rejections in light of the following arguments.

B. The Appellants' Invention

The present invention concerns the field of integrating FEA functions into a CAD program in order to obtain a unified design environment.

A prior art CAD program with integrated FEA functions is known under the trademark "Genius Desktop 3". As discussed in the paragraph bridging pages 2 and 3 of the application, the "Genius Desktop 3" product makes it possible to perform FEA for any three-dimensional body that has been defined using the underlying CAD functionality. However, there are limitations with respect to the possibilities for defining load and support conditions. In the "Genius Desktop 3" product, it is only possible to define forces and fixed and movable supports that act on individual points or along edges or on whole faces of a body.

These limitations restrict the kind of situations that can be modeled conveniently. Consider the example that a user wants to model the mechanical properties of a table on which a drinking glass has been placed. The weight of the drinking glass only acts on the (usually

circular) region where the glass contacts the table. It would be rather difficult, time-consuming and error-prone to model this situation in the "Genius Desktop 3" product.

The present invention as recited in independent claims 1, 16 and 20 has the important feature that a graphical function of the CAD program can be used to define a region within a face of a body, the region being used to define a load/support condition for an FEA calculation. The intended meaning of the terms "body" and "face" is the same as in the Boundary Representation Model, which is usually employed in connection with CAD technology. Examples of the use of these terms (as well as of the use of the term "edge") are shown in Fig. 6, Fig. 7b and Fig. 7c of the present application; in these figures, "B" denotes a body, "F" denotes a face, "E" denotes an edge, and "R" denotes a region within a face.

Making use of the above feature of the present invention, the situation of a drinking glass standing on a table can be modeled conveniently. The table is the body, and the upper face of the table plate is the face in the terminology of claims 1, 16 and 20. A graphical CAD function is used to define the region where the glass contacts the table within the face. For example, this graphical CAD function may simply be a function of drawing a disk onto the table face, or it may be a function of projecting a model of the glass onto the face. Then a load condition may be defined for the region within the face by stating that, e.g., a load of 1 Newton (representing the weight of the glass) acts on the entire defined region. The corresponding FEA calculations will then be performed.

C. <u>Arguments directed to the first grounds for rejection: Whether claims 1-6, 8, 9, 11-13, and 16-23 are anticipated under 35 U.S.C. §102(b) by St. Ville, U.S. Patent No. 5,594,651 (St. Ville).</u>

1. <u>Claims 1, 16 and 20</u>

St. Ville (U.S. Patent 5,594,651) discloses a method for manufacturing an object wherein CAD techniques are used and an FEA stress analysis is performed. The teaching of St. Ville primarily concerns the finding of proper materials and manufacturing parameters for obtaining the desired properties of the object. Aspects that concern the present invention, namely the integration of FEA functions into a CAD program, are not mentioned.

In particular, St. Ville does not disclose the feature that a graphical function of the CAD program can be used to define a region within a face of a body, the region being used to define a load/support condition for an FEA calculation.

With respect to this feature, paragraph (4) of the Office Action refers to the following portions of St. Ville:

- graphics software program, Col. 13, Line 56;
- computer-aided design, Col. 13, Line 55 and Col. 1, Line 49;
- region A-F, Fig. 5A;
- step "Identify forces applied to object in intended application" in Fig. 1, Sheet 1/11, Fig. 2.

Paragraph (5) of the Office Action further refers to the following portion of St. Ville:

- region, Col. 12, Line 53.

The above portions of St. Ville will now be considered in turn.

The disclosure in Col. 13, Lines 55-56 of St. Ville states that a CAD module 801 is a three-dimensional graphics software program for generating a geometrical model definition. However, a geometrical model definition is very different from a load/support condition. An FEA calculation needs both a geometrical model definition and a number of load/support conditions. The geometrical model represents the object on which the various forces defined by the load/support conditions act. The disclosure in Col. 13, Lines 55-56 of St. Ville only refers to geometrical models and not to load/support conditions. Presumably the load/support conditions are defined within the FEA software packages mentioned in Col. 14, Lines 18-22 without any interaction with the CAD module 801. All in all, Col. 13, Lines 55-56 of St. Ville does not disclose the feature that a graphical function of the CAD program can be used to define any entity – let alone a region within a face – that is used to define a load/support condition for an FEA calculation.

Col. 1, Line 46-48 of St. Ville teaches that the initial design geometry may be created using CAD techniques. This disclosure refers to step 11 shown in Fig. 1. According to Col. 1, Lines 48-50, the forces which will be applied to the object during use, and the points and directions of the respective forces – i.e., the load/support conditions – are identified in step 12

shown in Fig. 1. Step 12 is clearly separate from step 11. There is no disclosure of any use of CAD techniques for performing step 12. Again, neither Col. 1, Lines 46-50 nor Fig. 1 of St. Ville disclose that a graphical function of the CAD program can be used to define any entity – let alone a region within a face – that is used to define a load/support condition for an FEA calculation.

Fig. 5A of St. Ville is not relevant with respect to the present invention since Fig. 5 illustrates a real-life force of 2000 N acting on a point of an in vivo hip, i.e., the hip of a living person. Col. 6, Lines 22-23 and Col. 8, Lines 35-36. Fig. 5A, which shows a real-life situation and not a model, does not concern CAD programs or FEA calculations. Furthermore, elements A-F of Fig. 5A further do not represent regions, but points. Col. 8, Line 38. Fig. 5A therefore does not show a graphical function of the CAD program, does not show a region, and does not show any definition of a load/support condition for an FEA calculation. If anything, Fig. 5A teaches away from the present invention since the associated table in Fig. 5B defines displacements {x} for the points A-F in a textual and not in a graphical form.

Step 12 of Fig. 1 ("Identify forces applied to object in intended application") has already been discussed above. Again, there is no disclosure that a graphical function of the CAD program was used in step 12 in any way for defining FEA load/support conditions. In fact, St. Ville teaches that the "points and direction of application of the respective forces are identified at step 12". Col. 1, Lines 48-50. This disclosure seems to indicate that only forces acting on individual points – and not load/support conditions relating to regions – can be defined in the system of St. Ville.

Col. 12, Lines 53-54 of St. Ville discloses that the manufacturing process of a prosthesis can be controlled – by controlling the tightness of the weave of a composite material – to provide a region of high stiffness and a region of low stiffness. Clearly, these regions relate to the finished prosthesis and not to any definition of load/support conditions for an FEA calculation. There is also no disclosure in Col. 12, Lines 53-54 that any graphical function of a CAD program was used to define such regions. In this respect, it is remarked that the elements 601, 602, 603 shown in Fig. 6 are certainly not defined by any graphical CAD function. Instead, these elements 601, 602, 603 might possibly be the result of an automatic meshing operation performed by the

FEA software. Summing up, the high stiffness region and low stiffness region of the finished prosthesis, as disclosed in Col. 12, Lines 53-54 of St. Ville, are not defined by a CAD program and cannot be used to define a load/support condition for an FEA calculation.

Further portions of St. Ville also support the conclusion that St. Ville in fact teaches away from any use of a graphical function of a CAD program to define a region within a face of a body, the region being used to define a load/support condition for an FEA calculation.

According to St. Ville, different programs are employed for the CAD and FEA steps, respectively. Col. 9, Lines 1-59. While the FEA software uses the geometric model data generated by the CAD program, there is no indication that any graphical CAD function may be used to define a load/support condition.

St. Ville further states that "the finite element model is completed by specifying the values and/or directions of the above-described fields {f} and potentials {x} at the nodes of the discretized object". Col. 10, Lines 28-30. Again, this confirms that (1) the load/support conditions are defined not during the CAD steps on the geometric model data, but during the FEA steps on the finite element model data, (2) no graphical CAD function is used for defining the load/support conditions, and (3) only forces acting on points (and not forces acting on regions within faces) can be defined.

All in all, the disclosure of St. Ville is much farther away from the present invention than, e.g., the functions that have already been available in the prior art "Genius Desktop 3" product, as described on pages 2 and 3 of the present application and discussed above in section VII. B.

In section (22) of the Office Action, the Examiner disagreed with the arguments presented above, which were first submitted on December 09, 2004. However, the Examiner based his assessment on portions of St. Ville that are different from the portions mentioned in sections (4) and (5) of the Office Action.

Appellants' attorney respectfully disagrees with the assessment given in section (22) of the Office Action. It is submitted that the additional portions of St. Ville cited in section (22) do not anticipate the feature of the present invention that at least one graphical function of the CAD program is used to define a region within a face of a body, the region being used to define a

load/support condition for an FEA calculation. This feature will be called feature (*) in the following.

The portions cited in section (22) are:

- Fig. 3: steps (2) of 21, 22, and 2nd of 23 (there is no 3rd item of 23 in Fig. 3);
- Finite Element Analysis [Fig. 3: step 24]; and
- Pre-Processing [Fig. 3: step 22 and Col. 8, Lines 58-59];
- Sentence of the abstract of St. Ville: "A computerized mathematical model of the object is generated by discretizing the geometric model of the object into a plurality of finite elements and defining nodes at boundaries of the elements, wherein values of the field {f} and potential {x} are specified at the nodes".

The above portions of St. Ville will now be discussed in turn.

Fig. 3: steps (2) of 21, 22 and 2nd of 23 of St. Ville show various steps in the method of St. Ville. Col. 6, Lines 38-40.

Item (2) of step 21 reads "Forces ({f}) are known". This item refers to a force field that will be applied to the object in its intended use. Col. 8, Lines 1-3. There is no indication that these forces would be defined using a graphical function of a CAD program, and there is no indication that forces acting on a region within a face of a body (and not merely a point) can be defined. To the contrary, it would appear that the CAD program is only used later, namely in step 22.

Step 22 of Fig. 3 of St. Ville reads "Design model geometry". Here, computer aided design is used to geometrically model the object to be manufactured. Col. 8, Lines 58-59. There is no indication that any forces or load/support conditions are defined during this step.

The second item of step 23 of Fig. 3 reads "Input boundary conditions, including forces & potentials". This item apparently refers to Col. 10, Lines 27-31, which read "The finite element model is completed by specifying the values and/or directions of the above-described fields {f} and potentials {x} at the nodes of the discretized object. In addition, any appropriate boundary conditions are imposed." It should be noted that this description refers to the finite element model and not to the geometrical (CAD) model. The finite element model is created from the geometrical (CAD) model using an appropriate software package like, e.g., I-DEAS,

MSC/NASTRAN, ABAQUS, and ANSYS. Col. 9, Lines 45-46 and 50-59. None of these software packages are CAD programs. It is therefore apparent that no graphical CAD function can be used during this step.

All in all, Fig. 3 of St. Ville discloses that the forces {f} are known (item (2) of step 21) before the model geometry is designed (step 22). This order of steps teaches away from the present invention because, according to feature (*), the load/support condition is defined using a region that has in turn been defined using a graphical function of the CAD program. In other words, according to the present invention the load/support condition can only be defined after the CAD program has been used to define the region.

Fig. 3: step 24 of St. Ville discloses the finite element analysis. The present invention is not concerned with this step, but with the preliminary step of defining at least one parameter for a finite elements analysis.

The pre-processing of Fig. 3: step 22 and Col. 8, Lines 58-59, has already been discussed above. Again, this step just concerns the creation of the CAD model. It does not concern the definition of any load/support conditions since these conditions, according to the method of St. Ville, have already been defined earlier in item (2) of step 21.

The sentence of the abstract of St. Ville "A computerized mathematical model of the object is generated by discretizing the geometric model of the object into a plurality of finite elements and defining nodes at boundaries of the elements, wherein values of the field {f} and potential {x} are specified at the nodes" has been cited in the Office Action with the assessment that not only forces acting on points could be defined but forces acting of regions within faces could also be defined. This assessment is contested. The sentence discloses that values (possibly force values) at the nodes are defined. By definition, a node is always a point and never a region. Therefore, even if the "values at the nodes" related to the load/support conditions, it would be values acting on points (i.e., nodes) and not regions. Furthermore, the sentence refers to the node and element generation of step 23 of Fig. 3 of St. Ville. This is apparent from the words "elements" and "nodes" and also from the fact that the step of designing a geometric model of the object is mentioned in the abstract before the sentence cited by the

Examiner. Therefore, this sentence cited by the examiner does not have any relation to the geometric (CAD) model generation of step 22.

All in all, the cited sentence of the abstract of St. Ville neither discloses the use of any graphical CAD functions to define regions, nor discloses the use of such regions to define a load/support condition for the FEA calculation.

Roth (U.S. Patent No. 5,289,567) and Itoh (U.S. Patent No. 5,774,124) have only been cited in the Office Action with respect to some of the dependent claims. Both of these references concern FEA calculations. However, there is no disclosure in these references of using graphical CAD functions for defining FEA load/support conditions, let alone for defining a load/support condition that refers to a region within a face of a body processed by a CAD program.

Thus, Appellants' attorney submits that independent claims 1, 16, and 20 are allowable over St. Ville, Roth, and Itoh. Further, dependent claims 2-15, 17-19, and 21-23 are submitted to be allowable over St. Ville, Roth, and Itoh in the same manner, because they are dependent on independent claims 1, 16, and 20, respectively, and thus contain all the limitations of the independent claims.

In addition, dependent claims 2-15, 17-19, and 21-23 recite additional novel elements not shown by St. Ville, Roth, and Itoh.

2. <u>Claims 2, 17 and 21</u>

Claim 2 recites that step b) of claim 1 comprises at least one of the sub-steps of:

- selecting a type of said load/support condition to be defined,
- selecting said face of said body, and
- defining further properties of said load/support condition.

The Office Action asserts that Ville teaches selecting a type of load/support condition [force, stress-field, Col. 1, Line 29, Fig. 2] to be defined [determination, Col. 1, Line 29], selecting face of body [Fig. 6, Sheet 7/11], and defining further properties of load/support condition [The object maybe redesigned and/or new material may be selected, Col. 1, Line 37, Fig. 2].

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest these limitations of the claim. In particular, step b) of claim 1 requires that a graphical function of the CAD program is used for one of the above sub-steps. St. Ville does not teach or suggest this feature.

3. Claim 3

Claim 3 recites that said load/support condition for said FEA calculation is a condition selected from the following group of conditions:

- a load condition inside said region,
- a load condition outside of said region,
- a support condition inside said region, and
- a support condition outside of said region.

The Office Action asserts that Ville teaches a load condition inside region, a load condition outside of region, a support condition inside region, and a support condition outside of region. [Each force which will be applied to the object during intended use, and the points and direction of application of the respective forces, are identified, Col. 1, Line 48, Fig. 2] [Strains and stresses, Col. 2, Line 45]

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest these limitations of the claim. In particular, the above disclosure of St. Ville only refers to the points and directions of application of the respective forces and not to any region.

4. Claims 4, 17 and 21

Claims 4, 17 and 21 recite that said graphical function of said CAD program is a function selected from the following group of functions:

- a function of drawing an object, said object being used to delimit said region, and
- a function of selecting an object, said object being used to delimit said region.

The Office Action asserts that Ville teaches graphical function [graphics software program, Col. 13, Line 56] of CAD program [computer-aided design, Col. 13, Line 55] is a

function selected from the following group of functions: a function of drawing [paint, Col. 8, Line 66] an object [realistic picture, Col. 8, Line 66], object being used to delimit region [dividing the geometric model of the object, Col. 9, Line 60], and a function of selecting [variety of element shapes may be used, Col. 9, Line 64] an object [realistic picture, Col. 8, Line 66], object being used to delimit region.

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest drawing or selecting an object, wherein the object is used to delimit a region, in the same context as Appellants' claims. While it is, of course, known that CAD programs generally have functions to draw or select objects, there is no disclosure in St. Ville that such objects can be used to delimit a region that, in turn, is used to define a load/support condition for an FEA calculation.

5. Claim 5

Claim 5 recites that said object is drawn on said face of said body.

The Office Action asserts that Ville teaches object is drawn on face of body [Fig. 6, Sheet 7/11].

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest the limitations of these claims, in the same context as Appellants' claims. While it is known that CAD programs generally may be used to draw an object on a fact of a body, there is no disclosure in St. Ville that such an object can be used to delimit a region that, in turn, is used to define a load/support condition for the FEA calculation.

6. Claim 6

Claim 6 recites that the view in which said body is displayed by said CAD program is temporarily changed for facilitating drawing of said object.

The Office Action asserts that Ville teaches the view in which body [realistic picture, Col., Line 66] is displayed by CAD program [computer graphics output devices, Col. 8, Line 67] is temporarily changed [modified, Col. 9, Line 6] for facilitating drawing of object [initial geometric model, Col. 9, Line 5].

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest the limitations of these claims, in the same context as Appellants' claims.

7. Claim 7

Claim 7 recites that the step of calculating a projection of said object onto said face for determining said region.

The Office Action asserts that Ville teaches calculating [discretizing, Col. 18, Line 43] a projection of object [geometric model, Col. 18, Line 43] onto face [finite element, Col. 18, Line 44] for determining [generating, Col. 18, Line 42] region [computerized mathematical model, Col. 18, Line 42].

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest the limitations of these claims. In particular, the Office Action fails to identify any projection operation (of an object onto a face) in St. Ville.

8. Claim 8

Claim 8 recites that said graphical function of said CAD program is a function of subtracting a selected body from said body determined in step a).

The Office Action asserts that Ville teaches graphical function [computer graphics output devices, Col. 8, Line 67] of CAD program [computer aided design, Col. 8, Line 58] is a function of subtracting [modified, Col. 9, Line 6] a selected body [the object, Col. 8, Line 59] from body [the object, Col. 4, Line 47] determined in step (a).

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest the limitations of these claims. In particular, the modification of the initial geometric model mentioned in Col. 9, Line 6 of St. Ville has nothing to do with any definition of a load/support condition for an FEA calculation. Furthermore, the generic term "modified" does not teach or suggest the specific subtraction operation recited in claim 8.

9. Claims 9, 18 and 22

Claims 9, 18 and 22 recite that step b) is repeated to define a plurality of regions within at least one face of said body, each region of said plurality of regions being used to define at least one load/support condition for said FEA calculation.

The Office Action asserts that Ville teaches step (b) is repeated to define a plurality of regions within at least one face of body [Fig. 6, Sheet 7/11], each region of plurality of regions being used to define at least one load/support condition for FEA calculation [Identify force applied to object in intended application, Fig. 1, Sheet 1/11, Fig. 2].

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest repeatedly defining a region within a face of the body, the region being used to define a load/support condition for an FEA calculation, to define a plurality of regions, wherein each region is used to define at least one load/support condition for said FEA calculation.

10. Claim 12

Claim 12 recites that said face of said body is a curved face.

The Office Action asserts that Ville teaches face of body is a curved face. [Fig. 6, Sheet 7/11.

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest the limitations of these claims, in the same context as Appellants' claims.

11. Claim 13

Claim 13 recites that said region used to define said load/support condition is a curved region.

The Office Action asserts that Ville teaches region used to define load/support condition is a curved region. [Fig. 6, Sheet 7/11].

Appellants' attorney disagrees with this analysis, and submits that nowhere does the reference teach or suggest the limitations of these claims, in the same context as Appellants' claims.

D. Arguments directed to the second grounds for rejection: Whether claims 10, 11, 19, and 23 are obvious under 35 U.S.C. §103(a) over St. Ville, U.S. Patent No. 5,594,651 (St. Ville), in view of Roth, U.S. Patent No. 5,289,567 (Roth).

1. Claim 10

Claim 10 recites comprising at least one of the steps of determining intersection points between the defined plurality of regions and determining overlapping portions of said plurality of regions.

The Office Action asserts that Ville teaches, defines a region [define initial design geometry, Fig. 1, Sheet 1/11] to define a load support condition for FEA calculation [Identify force applied to object in intended application, Fig. 1, Sheet 1/11, Fig. 2]. The Office Action admits that Ville does not teach steps of determining intersection points between the defined plurality of regions and determining overlapping portions of plurality of regions. However, the Office Action asserts that Roth teaches at least one of the steps of determining [checked, Col. 8, Line 30] intersection points [intersection, Col. 8, Line 31] between the defined pluralities of regions [bounding boxes, Col. 8, Line 31] and determining [determine, Col. 8, Line 38] overlapping portions [overlapping points, Col. 8, Line 38] of plurality of regions [bounding boxes, Col. 8, Line 31]. According to the Office Action, it would have been obvious to a person of ordinary skill in the art to modify the teaching of Roth to include "steps of determining intersection points between the defined plurality of regions and determining overlapping portions of plurality of regions," with the motivation to provide for determining if there exist overlapping points or line segments in the model. And a logarithmic time per line rather than a linear query time is achieved.

Appellants' attorney disagrees with this analysis, and submits that nowhere does Roth teach or suggest determining intersection points between the regions and determining overlapping portions of the regions, in the same context as Appellants' claims. In particular,

Roth only discloses a determination of overlapping points or line segments (Col. 8, Line 38 - 39), i.e., zero-dimensional or one-dimensional entities. Roth does not teach or suggest a determination of overlapping portions of regions, i.e., two-dimensional entities. In fact, it is clear from Fig. 4a of Roth that the geometric finite element method disclosed therein only uses non-overlapping elements. Furthermore, the disclosure of Roth concerns features of a geometric model and not the definition of load/support conditions for an FEA calculation. Moreover, any suggestion to modify Roth to accomplish these elements comes from the Office Action itself, and not from the cited references.

2. Claims 11, 19 and 23

Claims 11, 19 and 23 recite that the loads acting on overlapping portions of said plurality of regions are defined as the sums of the individual loads acting on each region.

The Office Action asserts that Ville teaches the loads [loads, Col. 4, Line 4] acting on [applied to, Col. 4, Line 4] regions [the object, Col. 4, Line 4] are defined as the sums [displacement resulting, Col. 4, Line 6] of the individual loads acting on each region [application of the loads, Col. 4, Line 7]. The Office Action admits that Ville does not teach overlapping portions of plurality of regions. However, the Office Action asserts that Roth teaches overlapping portions [overlapping points, Col. 8, Line 38] of plurality of regions [bounding boxes, Col. 8, Line 31]. Therefore, the Office Action asserts that it would have been obvious to a person of ordinary skill in the art to modify the teaching of Roth to include "overlapping portions of plurality of regions," with the motivation to provide for determining if there exist over lapping points or line segments in the model. And a logarithmic time per line rather than a linear query time is achieved.

Appellants' attorney disagrees with this analysis, and submits that nowhere does Roth teach or suggest the loads acting on overlapping portions of the regions are defined as the sums of the individual loads acting on each region, in the same context as Appellants' claims. Reference is made to the arguments given above with respect to Claim 10. Moreover, any suggestion to modify Roth to accomplish these elements comes from the Office Action itself, and not from the cited references.

E. Arguments directed to the third grounds for rejection: Whether claims 14 and 15 are obvious under 35 U.S.C. §103(a) over St. Ville, U.S. Patent No. 5,594,651 (St. Ville), in view of Itoh et al., U.S. Patent No. 5,774,124 (Itoh).

1. Claim 14

Claim 14 recites the further step of determining contact points of said region to an edge of said face.

The Office Action asserts that Ville teaches (a) determining a body [the object, Col. 4, Line 47] for which parameter [manufacturing parameter, Col. 4, Line 59] is to be defined [determined, Col. 4, Line 61], body [the object, Col. 8, Line 59] being an entity processed [geometrically model, Col. 8, Line 58] by CAD program [computer-aided design, Col. 8, Line 58]; and (b) using at least one graphical function [graphics software program, Col. 13, Line 56] of CAD program [computer-aided design, Col. 13, Line 55] to define a region within a face of body [define initial design geometry, Fig. 1, Sheet 1/11], region being used to define a load/support condition for FEA calculation [Identify forces applied to object intended application, Fig. 1, Sheet 1/11]. However, the Office Action admits that Ville does not teach the further step of determining contact points of region to an edge of face. Nonetheless, the Office Action asserts that Itoh teaches further step of determining contact [aligned along, Col. 2, Line 32] points of region [region boundary, Col. 2, Line 32] to an edge of face [sides of the element, Col. 2, Line 31]. Therefore, the Office Action asserts that it would have been obvious to a person of ordinary skill in the art to modify the teaching of Itoh to include "further step of determining contact points of region to an edge of face," with the motivation to provide a method and system for automatically generating quadrilateral meshes for reducing the problem to one of a finite number of unknowns by dividing the solution region into elements and by expressing the unknown field variable in terms of assumed approximating functions within each element.

Appellants' attorney disagrees with this analysis, and submits that nowhere does Itoh teach or suggest determining contact points of the region to an edge of said face, in the same context as Appellants' claims. In particular, Itoh only concerns a conversion of a triangular mesh into a quadrilateral mesh within a single face. Itoh does not teach or suggest that any

further region that is defined within the face is taken into account. Moreover, any suggestion to modify Itoh to accomplish these elements comes from the Office Action itself, and not from the cited references.

2. Claim 15

Claim 15 recites that mesh elements are generated in a meshing step of said FEA calculation such that the borders of the mesh elements follow the borders of said region.

The Office Action asserts that Ville teaches (a) determining a body [the object, Col. 4, Line 47] for which parameter [manufacturing parameter, Col. 4, Line 59] is to be defined [determined, Col. 4, Line 61], body [the object, Col. 8, Line 59] being an entity processed [geometrically model, Col. 8, Line 58] by CAD program [computer-aided design, Col. 8, Line 58]; and (b) using at least one graphical function [graphics software program, Col. 13, Line 56] of CAD program [computer-aided design, Col. 13, Line 55] to define a region within a face of body [define initial design geometry, Fig. 1, Sheet 1/11], region being used to define a load/support condition for FEA calculation [Identify forces applied to object intended application, Fig. 1, Sheet 1/11]. However, the Office Action admits that Ville does not teach mesh elements are generated in a meshing step of said FEA calculation such that the borders of the mesh elements follow the borders of said region. Nonetheless, the Office Action asserts that Itoh teaches mesh elements [mesh division, Col. 1, Line 18] are generated in a meshing step [dividing, Col. 1, Line 18] of FEA calculation [finite element analysis, Col. 1, Line 20] such that the borders of the mesh elements [sides of elements, Col. 2, Line 32] follow [aligned along, Col. 2, Line 33] the borders of region [region boundary, Col. 2, Line 33]. Therefore, the Office Action asserts that it would have been obvious to a person of ordinary skill in the art to modify the teaching of Itoh to include "mesh elements are generated in a meshing step of said FEA calculation such that the borders of the mesh elements follow the borders of said region," with the motivation to provide a method and system for automatically generating quadrilateral meshes for reducing the problem to one of a finite number of unknowns by dividing the solution region into elements and by expressing the unknown field variable in terms of assumed approximating functions within each element.

Appellants' attorney disagrees with this analysis, and submits that nowhere does Itoh teach or suggest that mesh elements are generated in a meshing step of said FEA calculation such that the borders of the mesh elements follow the borders of said region, in the same context as Appellants' claims. Reference is made to the arguments given above with respect to Claim 14. Moreover, any suggestion to modify Itoh to accomplish these elements comes from the Office Action itself, and not from the cited references.

VIII. CONCLUSION

In light of the above arguments, Appellants' attorney respectfully submits that the cited references do not anticipate nor render obvious the claimed invention. More specifically, Appellants' claims recite novel physical features, which patentably distinguish over any and all references under 35 U.S.C. §§ 102 and 103. As a result, a decision by the Board of Patent Appeals and Interferences reversing the Examiner and directing allowance of the pending claims in the subject application is respectfully solicited.

Respectfully submitted,

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APPENDIX

1. A method for defining at least one parameter for a finite elements analysis (FEA) calculation in a computer-assisted drafting (CAD) program, said method comprising:

a) determining a body for which said parameter is to be defined, said body being an entity processed by said CAD program; and

b) using at least one graphical function of said CAD program to define a region within a face of said body, said region being used to define a load/support condition for said FEA calculation.

2. The method of claim 1, wherein step b) comprises at least one of the sub-steps of:

- selecting a type of said load/support condition to be defined,
- selecting said face of said body, and
- defining further properties of said load/support condition.

3. The method of claim 1, wherein said load/support condition for said FEA calculation is a condition selected from the following group of conditions:

- a load condition inside said region,
- a load condition outside of said region,
- a support condition inside said region, and
- a support condition outside of said region.

4. The method of claim 1, wherein said graphical function of said CAD program is a function selected from the following group of functions:

- a function of drawing an object, said object being used to delimit said region, and
- a function of selecting an object, said object being used to delimit said region.

5. The method of claim 4, wherein said object is drawn on said face of said body.

6. The method of claim 4, wherein the view in which said body is displayed by said CAD program is temporarily changed for facilitating drawing of said object.

7. The method of claim 4, comprising the step of calculating a projection of said object onto said face for determining said region.

8. The method of claim 1, wherein said graphical function of said CAD program is a function of subtracting a selected body from said body determined in step a).

9. The method of claim 1, wherein step b) is repeated to define a plurality of regions within at least one face of said body, each region of said plurality of regions being used to define at least one load/support condition for said FEA calculation.

10. The method of claim 9, further comprising at least one of the steps of determining intersection points between the defined plurality of regions and determining overlapping portions of said plurality of regions.

11. The method of claim 9, wherein the loads acting on overlapping portions of said plurality of regions are defined as the sums of the individual loads acting on each region.

12. The method of claim 1, wherein said face of said body is a curved face.

13. The method of claim 1, wherein said region used to define said load/support condition is a curved region.

14. The method of claim 1, comprising the further step of determining contact points of said region to an edge of said face.

15. The method of claim 1, wherein mesh elements are generated in a meshing step of said FEA calculation such that the borders of the mesh elements follow the borders of said region.

16. A computer program product for execution by a general purpose computer for defining at least one parameter for a finite elements analysis (FEA) calculation in a computer-assisted drafting (CAD) program, said computer program product including instructions for determining a body for which said parameter is to be defined, said body being an entity processed by said CAD program, and said computer program product further including instructions for defining a region within a face of said body using at least one graphical function of said CAD program, said region being used to define a load/support condition for said FEA calculation.

17. The computer program product of claim 16, wherein said graphical function of said CAD program is a function selected from the following group of functions:

- a function of drawing an object, said object being used to delimit said region, and
- a function of selecting an object, said object being used to delimit said region.

18. The computer program product of claim 16, wherein a plurality of regions is defined within at least one face of said body, each region of said plurality of regions being used to define at least one load/support condition for said FEA calculation.

19. The computer program product of claim 18, wherein the loads acting on overlapping portions of said plurality of regions are defined as the sums of the individual loads acting on each region.

20. An apparatus comprising a general purpose computer programmed for defining at least one parameter for a finite elements analysis (FEA) calculation in a computer-assisted drafting (CAD) program, said general purpose computer being programmed for determining a body for which said parameter is to be defined, said body being an entity processed by said CAD program; and said general purpose computer being further programmed for defining a region within a face of said body using at least one graphical function of said CAD program, said region being used to define a load/support condition for said FEA calculation.

21. The apparatus of claim 20, wherein said graphical function of said CAD program is a function selected from the following group of functions:

- a function of drawing an object, said object being used to delimit said region, and
- a function of selecting an object, said object being used to delimit said region.

22. The apparatus of claim 20, wherein a plurality of regions is defined within at least one face of said body, each region of said plurality of regions being used to define at least one load/support condition for said FEA calculation.

23. The apparatus of claim 22, wherein the loads acting on overlapping portions of said plurality of regions are defined as the sums of the individual loads acting on each region.